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INSTITUTE OF GAS TECHNOLOGY

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GAS ABSTRACTS

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1. GAS INDUSTRY

Conversions

Andrew, H. O. HOW CONVERSION TO NATURAL GAS EXPANDS SALES, EMPLOYMENT. *Gas Age* **105**, 27, 29-31 (1950) *March* 16.

A survey of twenty utility companies has indicated that change-over to natural gas does not result in the down-grading of company employees or in loss of employment. Both gas sales and numbers of employees increase. Gas-making employees at the time of change-over are generally absorbed into expanded departments of the company at the same salary level.

J. C. Lane

Turpish, J. V. HOW STATEN ISLAND CONVERTED TO NATURAL GAS. *Gas Age* **105**, 17-22, 58-60, 62 (1950) *March* 30.

The experiences of the New York and Richmond Gas Company in converting its 40,000-odd meter system from 540 Btu carbureted water gas to 1030 Btu natural gas are discussed in considerable detail. The system was converted in sections with combined direct mailing and newspaper advertising to notify customers of the date of conversion in their areas. The major difficulties encountered in adapting each type of appliance to natural gas operation are recorded.

J. C. Lane

ECONOMICS OF GAS CONVERSIONS. *Am. Gas Assoc. Monthly* **32**, 17-18, 45 (1950) *April*.

The American Gas Association has completed a survey of the experiences of 21 companies which have undertaken 32 conversions in gas sendout since 1932. Twenty-five of the conversions were from manufactured gas to natural; four were from mixed gas to natural; two were from manufactured gas to LP-gas; and one was from manufactured gas to mixed. Composite statistics are published. The individual replies are available for study at A.G.A. headquarters or may be had as photostatic copies. The composite experience indicates probable substantial increases in sales to all classes of customers with accompanying but more modest increases in operating revenues for companies converting to natural gas.

J. C. Lane

FPC Regulation

Behling, B. N. SHIFTING FPC VIEWPOINT OBSCURES INTENT OF NATURAL GAS ACT. *Am. Gas J.* **172**, 21-22, 44 (1950) *March*.

The Federal Power Commission's attempt to regulate the field price of natural gas sold by independent producers and gatherers to interstate pipe lines threatens the growth of the natural gas industry and, if carried out, probably would result in less gas and higher priced gas for the domestic consumer. Until the interstate pipe lines supplied a market, the field price of natural gas was that of a next-to-worthless by-product. Even today, the field price is still far below the actual value of the gas as a fuel, since long-term contracts are based on the distress market of earlier years. Escalator clauses in new contracts provide for only small increases in field prices at long intervals of time. A fair price for natural gas must be obtained to encourage further discoveries. The threat of price control already is influencing producers to reserve their gas for use within their own states to avoid potential FPC regulation. Unless this situation is rectified by legislation, gas may not be available to out-of-state consumers. The FPC's plan for price control would drive out of the interstate market all but the highest cost producers who would obtain a higher price for their gas because of their higher cost.

J. C. Lane

Gas Chemicals

Sandifer, T. P. WHAT ELSE IS GAS GOOD FOR? *Public Utilities Fortnightly* **45**, 355-358 (1950) *March* 16.

The gas industry has become a major producer of chemical intermediates. Of the 1,022 billion gallons of tar recovered from all sources in 1948, 269 million gallons, or 26.3%, consisted of tar from water gas and oil gas operations. Natural gas and petroleum are major sources of crude products for chemicals manufacture, accounting for a marketed production of three

billion pounds of such products valued at $123 million in 1948. The production of organic chemicals from raw materials other than coal tar is considered still in an early stage. The instability of coal production may accelerate the trend to natural gas and petroleum raw materials.

J. C. Lane

Markets

Massey, H. and Martin, E. R. SET YOUR OWN HORIZONS IF YOU USE ALL SALES TOOLS. *Gas Age* **105**, 19-21, 70, 72 (1950) *April* 19.

The introduction of natural gas to the Northeastern states is opening the nation's most concentrated and economically powerful area to gas house heating and other applications of gas. The proportion of gas heating customers to total gas utility customers in this area is only 8% as compared with a national average of 33%, indicating a large potential market.

J. C. Lane

Pipe Lines

Zitnik, L. J. THE MARCH OF THE GAS TRANSMISSION LINES. *Public Utilities Fortnightly* **45**, 484-488 (1950) *April* 13.

During the five-year period 1948-52, the natural gas industry will spend $1.75 billion for new transmission facilities, more than doubling the delivery capacity of 4.34 billion cubic feet which existed on January 1, 1946. Since the need for each new system or system expansion and the availability of an adequate gas supply are appraised by the Federal Power Commission, the current record expansion program is on an economically sound basis. Indications are that natural gas will continue to offer the most desirable fuel at the lowest price per unit of heat. Comparative fuel costs in the area served by the Panhandle Eastern Pipe Line system, which is near some of the nation's greatest coal deposits, bear out this assumption. In this area, the wholesale cost of coal increased 125% from 1938 to 1948, while the cost of fuel oil increased 116%. During this same period, the cost of natural gas in the area decreased by 32%. At the end of 1948, the cost per heat unit of coal was 90.5% higher than that of natural gas, and the cost of fuel oil was 187% above that of natural gas.

J. C. Lane

FPC APPROVED 7,571 MILES OF NEW GAS LINE CONSTRUCTION IN 1949. *Pipe Line News* **22**, 13-14 (1950) *April*.

Natural gas transmission facilities totaling more than one billion cubic feet in daily delivery capacity were authorized during the last six months of 1949. These facilities will cost an estimated 195.6 million dollars and will total 2,637 miles of pipe. During the calendar year 1949, the FPC authorized 7,541 miles of pipe line and installation of compressor units aggregating 499,800 horsepower; the total estimated cost of these facilities being 615.2 million dollars.

J. C. Lane

Refineries

NORTH AMERICAN OPERATING REFINERIES. *Oil Gas J.* **48**, 305-306, 309, 311-314, 317-318, 321-322 (1950) *March* 23.

The refineries currently in operation in North America are listed by location together with their charging capacity, thermal and catalytic cracking capacities and types of processes employed.

J. C. Lane

Reserves

NATURAL GAS RESERVES NOW TOTAL 180 TRILLION CUBIC FEET. *Gas* **26**, 38-39 (1950) *April*.

Additions to the nation's estimated proved natural gas reserves totaled almost 12.7 trillion cubic feet during 1949, while production for the year was about 6.2 trillion cubic feet, resulting in a net increase of 6.5 trillion cubic feet and raising the total proved reserves to a new peak of 180 trillion cubic feet. The proved reserves of natural gas liquids at the end of 1949 were 3.73 billion barrels as contrasted with 3.54 billion barrels at the close of 1948.

J. C. Lane

Securities

Abrams, E. R. WHY LIFE INSURANCE COMPANIES BUY NATURAL GAS PIPELINE BONDS. *Public Utilities Fortnightly* 45, 542-545 (1950) *April* 27.

Life insurance companies have found the bonds of natural gas pipeline companies a most attractive investment. They have bought over one billion dollars of these securities during the last fifteen years without a single instance of default or loss. Specific questions regarding a pipeline company's position are always asked to assure the soundness of the investment. First, does the pipeline have long-term gas purchase and sales contracts? The minimum satisfactory ratio of reserves to pipeline capacity is considered to be one trillion cubic feet for each 100,000,000 cubic feet of daily deliverability. Long term "take or pay for" contracts for the sale of most or all of the capacity for twenty years are favored. The second question regards the physical adequacy of the reserves and the sinking-fund provisions. The insurance companies protect themselves against the risk of depleted gas supplies by requiring a check each third year by independent experts. If the reserves are found to be diminishing at too rapid a rate, the sinking-fund payments are accelerated. The third question, "Are the estimated earnings sufficient to provide adequate coverage of interest and sinking-fund requirements?" is usually answered in the affirmative by the existence of the "take or pay for" sales contracts. The fourth question, "Is the capital structure sound?" has been answered by fifteen years of experience indicating that pipelines can have high ratios of debt to combined capitalization and surplus without danger.

J. C. Lane

Security Regulation

WHAT OTHERS THINK: ARGUMENTS FOR NATURAL GAS SECURITY REGULATION; ARGUMENTS AGAINST NATURAL GAS SECURITY REGULATION. *Public Utilities Fortnightly* 45, 376-379 (1950) *March* 16.

Nelson L. Smith, Chairman of the Federal Power Commission, recently stated his arguments in favor of the Crosser bill which would bring the regulation of securities issued by the natural gas industry under FPC jurisdiction. He stressed the high debt ratio financing of pipe lines as a matter for regulatory scrutiny to protect investors and consumers, although he admitted that no detriment to either group has developed from such debt ratios to date. He called for changes in the bill to define the jurisdiction of the Securities Exchange Commission and the FPC and to exempt companies operating totally within a state. Scott Hughes of the Independent Natural Gas Association of America testified that the Crosser bill would substitute the FPC's judgment for that of management and the state regulatory bodies without performing any useful function. L. Dan Jones, attorney for the Independent Petroleum Association of America, recommended that no action be taken on the bill until the confusion regarding the jurisdictional status of producers and gatherers under the Natural Gas Act is clarified by other legislation. He testified that the Crosser bill would destroy the initiative to produce oil and gas, a result against the best interest of both industry and public.

J. C. Lane

Synthetic Fuel Cost

COST OF SYNTHETIC FUELS. *Chem. Eng. News* 28, 1187 (1950) *April* 10.

The cost estimates contained in the annual report (1949) on the Bureau of Mines synthetic liquid fuels program are summarized. (See *Gas Abstracts* 6, 67 (1950) April.)

C. H. Riesz

SYNTHETICS "CONFUSION"; SOLLIDAY SAYS CHAPMAN IS MISLEADING THE PUBLIC WHEN HE SAYS SYNTHETIC LIQUID FUELS COST ONLY 9 CENTS A GALLON. *Oil Gas J.* 48, 160 (1950) *March* 23.

A. G. Solliday, executive vice president of Stanolind Oil and Gas Company, challenges the Bureau of Mines synthetic fuels cost estimates. He stated that (1) cost of housing workers at remote shale mines and transportation of products to market area are omitted, (2) low-premium products, such as jet, diesel and residual fuels, are used in the computation, (3)

too low a return on capital investment (3%) is permitted on this risk venture, and (4) capital investment is at unrealistic low levels. Industry estimates of 22.5 cents per gallon of gasoline are cited as against the Bureau's estimates of 9 cents from oil shale and 14.5 cents from coal hydrogenation.

C. H. Riesz

The following article, which has not been abstracted, is also called to your attention:

NATURAL GAS PRODUCTION WILL CONTINUE RECORD EXPANSION. *World Oil* 130, 126-128, 131 (1950) *February* 15.

2. APPLIANCES

Appliance Performance

Minchin, L. T. GAS QUALITY AND APPLIANCE PERFORMANCE. *Gas World* (British) 131, 248-251 (1950) *March* 4.

A brief review of the methods for determining the flame stability and combustion characteristics of different gases is given. The author proposes that (1) the input rate to appliance burners should be held constant (Wobbe Index) and (2) a method for assessment of the combustion characteristics is needed, but in lieu of such a development a test burner is an excellent substitute.

E. F. Davis

Minchin, L. T. GAS QUALITY AND APPLIANCE PERFORMANCE. *Gas Times* (British) 62, 450, 452-4 (1950) *March* 24.

A comparison is made between the various combustion diagrams and performance of the Aeration Test Burner when interchanging manufactured gases. Limitations of the ATB are also discussed.

E. F. Davis

Burners

Minster, H. S. MULTIPLE GAS BURNER WITH PRESSURE-GOVERNED VALVES. U. S. Patent 2,494,190 (1950) January 10.

A high-low range top burner utilizing one valve and one venturi has been devised. The gas mixture is allowed to flow to one of two sets of ports by a balanced valve assembly in the burner head, the balance being controlled by the amount of gas flowing at the orifice.

E. F. Davis

Richardson, H. K. PROBLEMS PRESENTED BY CERAMIC BURNERS WHEN CONVERTING TO NATURAL GAS. *Am. Gas J.* 172, 26-29 (1950) *March*.

Some of the details of changes required in radiant cup, superheat and tunnel burners when converted from manufactured gas to natural gas are presented. Applications of the burners to several processes are discussed.

E. F. Davis

Standards

GAS INDUSTRY STANDARDS ADOPTED. *Am. Gas Assoc. Monthly* 32, 33, 48 (1950) *April*.

American Standards Approval requirements for installation of house piping and for performance tests on central heating plants installed in confined spaces have been revised. New requirements will become effective January 1, 1951.

E. F. Davis

3. COMBUSTION AND INDUSTRIAL FURNACES

Cyclone Furnace

Gilg, F. X. THE CYCLONE FURNACE—LATEST THING IN COAL BURNING: WHAT IT IS, HOW IT WORKS AND WHAT RESULTS IT PRODUCES. *Power Generation* 54, 64-70 (1950) *April.*

Designed for the combustion of ¼ in. crushed coal in steam generating units, the cyclone furnace represents a new development in the handling of poorer grade, moderate to high ash coals at ash slagging conditions. Operating on the vortex principle, the cyclone furnace produces on its periphery a viscous film of molten ash which traps both fly ash and larger coal particles, resulting in a thorough scouring action with the rapidly moving air stream and an effective removal of approximately 85% of the ash from the system. Capable of developing temperatures up to 3000° F and heat releases greater than 400,000 Btu per hr per cu ft furnace volume, the unit has a higher boiler efficiency than conventional furnaces due to a low (10%) excess air requirement, low combustible loss in the ash, and better heat absorption from cleaner tube surfaces. Other typical advantages of the system include: (a) low power cost for coal preparation; (b) elimination of expensive de-slagging equipment, dust precipitators and collectors, and induced draft fans; (c) low maintenance cost due to water-cooled construction and the absence of moving parts; (d) simple combustion controls and stability of ignition at all load conditions. Diagrams and operating test data are included.

C. Von Fredersdorff

Flame Study

Andersen, J. W. and Fein, R. S. MEASUREMENT OF NORMAL BURNING VELOCITIES OF PROPANE—AIR FLAMES FROM SHADOW PHOTOGRAPHS. *J. Chem. Physics* 18, 441-443 (1950) *April.*

It is stated that the introduction of fine particles into a propane-air flame leaner than 3.8% propane causes a reduction in the burning velocity. This method was employed by Lewis and Von Elbe to make normal burning velocity determinations. To obtain further data on lean mixtures the velocities were measured by use of shadow photographs and applying the Gouy formula. These results check with the particle method.

E. F. Davis

Campbell, J. R., Cumming, A.P.C. and Horn, J. A. STUDIES IN ACETYLENE FLAMES. Part II. FORMATION OF CARBON MONOXIDE. *J. Soc. Chem. Ind.* (British) 69, 21-25 (1950) *January.*

Carbon monoxide is found in the flue products from non-aerated 0.5-in. acetylene flames burning in a 1.5-in. combustion chamber supplied with a secondary atmosphere of 21% O_2 content and the quantity of CO increases as the O_2 content is reduced to 11%, the minimum extinction point. At 14.4% O_2 the CO content is 0.02%, while at 11% O_2, 0.11% CO is obtained. Additions of CO_2 to the secondary atmosphere increase the CO content of the combustion products. The experimental results obtained with 1-in. and 2-in. flames are complicated by the production of H_2, soot and other cracked products even in 2-in. and 3-in. combustion chambers.

A. J. Rudnitzki

Gas Turbine

COMMERCIAL GAS TURBINE OPERATION NOW ACHIEVED. *Combustion* 21, 41-42 (1950) *March.*

Successful operation of a two-stage, open-cycle, natural gas-fired central station gas turbine has been achieved since July, 1949 at the Oklahoma Gas and Electric Company. Driving a 15-stage axial flow compressor and a 3500 kw generator, the unit also recovers heat from exhaust gases for feedwater preheating for an adjacent steam plant, and requires a heat rate of 21,960 Btu/kwhr for the turbine alone or 16,220 Btu/kwhr for the combination gas turbine-steam plant. The investment cost is $208 per kw rated capacity. The first successful application of the gas turbine to locomotive service is seen in a 4500 hp turbine-electric unit operating since June, 1949. Built by General

Electric Company and the American Locomotive Company, the unit incorporates a 15-stage axial flow compressor having 5.9 to 1 pressure ratio, and operates with Bunker C fuel oil. Considerable experimental work is progressing at the present time to improve construction details such as turbine blades and rotor, and to increase permissible operating temperatures through the development of high temperature alloys. A brief summary of gas turbine history is given.

C. Von Fredersdorff

Industrial Heat Transfer

Baulk, R. H. INSTRUMENTS AND TECHNIQUES IN INDUSTRIAL HEAT-TRANSFER RESEARCH. *J. Inst. Fuel* (British) **23**, 77-85 (1950) *March*.

An earlier discussion of the problem (cf. *Gas Abstracts* **6**, 40 (1950) *March*) has been extended (1) to give a description of the construction and theory of a sensible heat meter or spray calorimeter, and (2) to illustrate the application of existing heat transfer data to the design of boiler tubes.

A. J. Rudnitzki

Abstractor's Note: A typographical error appears in the heat balance equation for the spray calorimeter. The equation should read:

$$\text{Heat content of} = Q + (t_2 - t_1)[G - R(M - m)]/R.$$

The following article, the abstract for which appears on the page indicated, is also called to your attention:

Berets, D. J., Greene, E. F. and Kistiakowsky, G. B. GASEOUS DETONATIONS. P. 95

4. CARBONIZATION AND GASIFICATION

Coal Constitution

Horton, L. PROGRESS REVIEW NO. 6. THE CONSTITUTION OF COAL. *J. Inst. Fuel* (British) **23**, 91-95 (1950) *March*.

The constitution of coal is outlined broadly as seen at present. Origin of coal is discussed in terms of geologic processes, plant structure and constitution, and microbiological decay of vegetation. Rank of coal, Hilt's law, and the primary types of coal with their distinguishing constituents are treated under petrology. The usefulness of petrology as related to use properties has been quite limited. In regard to explanation of constitution specifically, the results of solvent extraction, hydrogenation and oxidation have been of some use, but the products are still too complex. Physical methods of examination such as the studies of x-ray diffraction, porosity and density, and optical reflectivity have been more helpful, in that more consistent pictures of coal structure can be postulated. The nature and extent of inorganic content of coal and its influence are discussed briefly. A bibliography of 86 references is given.

O. P. Brysch

Coal Extraction

Golumbic, C., Anderson, J. B., Orchin, M. and Storch, H. H. SOLVENT EXTRACTION OF COAL BY AROMATIC COMPOUNDS AT ATMOSPHERIC PRESSURE. *U. S. Bureau of Mines Report of Investigations* 4662 (1950) *March*.

Recent experiments of the Bureau of Mines on extraction of coals with high-boiling aromatic compounds is described. Phenanthrene, 5,6-benzoquinoline, 5,6-benzoquinaldine, phenanthridine and carbazole in order are the most powerful of the 19 solvents tested, yielding 88 to 95% extraction of bituminous coal. Coals of all ranks were tested. Fractionation of the phenanthrene extract was made by solution in benzene and cyclohexane, and analyses, coking character and hydrogenation data are reported.

O. P. Brysch

Coal for Coke

Fieldner, A. C. COAL FOR COKE PRODUCTION. *U. S. Bureau of Mines Information Circular* 7559 (1950) *March.*

In comparison to other countries, the United States is fortunate in having large reserves of coal suitable for metallurgical coke. Since 95% of the coals presently coked come from the Eastern Province, some of the best beds have been exhausted, and much research is necessary for the development of better methods of removal of mineral-matter and sulfur. The practice of utilizing low-rank coals by blending with those of high-rank should be extended. There is only a limited supply of low-volatile coal, and it will be necessary to develop a substitute such as low-temperature coke. A new survey of our coal resources is being made by the Bureau of Mines and the Geological Survey.

W. E. Ball

Coal Preparation

Fraser, T., Crentz, W. L., and Bailey, A. L. HIGH-SULFUR PITTSBURGH COAL: UPGRADING IN SOUTHWESTERN PENNSYLVANIA AND NORTHERN WEST VIRGINIA. *U. S. Bureau of Mines Bulletin* 483 (1950).

Large reserves of high sulfur Pittsburgh bed coals remaining in S.W. Pennsylvania and N. West Virginia would become available for metallurgical fuels if intensive preparatory treatment were applied. Selective mining, low-gravity separation, fine crushing and froth flotation, and combination of the three must be employed to reduce the sulfur content, especially the pyritic form, any significant amount. Detailed washability data are presented on 56 samples from 5 mines in this area.

O. P. Brysch

Coal Tar

COAL-TAR TECHNOLOGY. *Coke & Gas* (British) 12. 93-98 (1950) *March.*

The newly-formed Coal Tar Research Association (British) has recently released a selective review of publications, "Review of Coal Tar Technology," covering the period from January to June, 1949. Numerous references are given not only to coal tar, but also to light oil and allied subjects of interest to the carbonization industry.

W. E. Ball

Coke

Hodgson, R. THE VOLATILE CONTENT OF COKE. *Gas J.* (British) **261**, 786, 790 (1950) *March* 29.

The thermal value of the residual volatile matter of coke is of great importance to the consumer from the standpoint of ignitability. A method (B.S.S. 1016/1942) is described for removal by evacuation of the residual volatiles from 500° to 1100°C. Two samples W.D. continuous vertical retort coke both showed 2.5 to 2.6% total volatiles, but the collected volatiles ($CO + H_2$) varied considerably—140 and 260 Btu. Such low values are too expensive to recover as gaseous therms, but a knowledge and control of this factor of coke quality is desirable.

O. P. Brysch

Coking

Powell, A. R. COKING PROCESS. U. S. Patent 2,495,763 (1950) January 31.

This invention provides a means whereby coal and coal mixtures that are ordinarily expanding may be coked in modern, commercial, high-capacity ovens without development of such expansion or resultant damage to the coke oven walls. Also, the method permits the use of such coals without reduction in the coke quality or in the operating capacity. Such results are attained by providing, during the charging of the oven, the introduction of a layer of material relatively heat-insulating and gas-permeable when carbonized, such as coke breeze, coal of low bulk density, or coal of high plasticity, which *interrupts the formation of a continuous plastic envelope* impenetrable to the flow of gases trapped within during the latter portion of the coking period.

O. P. Brysch

Dry Coke Cooling

DISCUSSION ON "DRY COOLING OF COKE". *J. Inst. Fuel* (British) 23, 96-102, 106 (1950) *March*.

Since facilities were unavailable for testing of wet-quenched and dry-cooled coke in the same blast furnace and under the same operating conditions, the B.I.S.R.A. had restricted their study to the recovery and use of sensible heat in iron and steel works. The Ministry of Fuel and Power Working Group studied heat recovery from the viewpoint of various types of carbonization plant. Recovery of such heat should show a profit, but the savings obtained with dry cooled coke itself were not visible in enhanced prices, and had not yet been assessed in the blast furnace. Credits in the form of steam, or marketable breeze or rescreening costs were still somewhat obscured by unsettled design and maintenance of the cooling plant, or its relationship to the capacity of the coke ovens, the furnace, and the power raising and power-consuming facilities of the integrated works. The question of whether or not to install dry-cooling in certain conditions remained open.

O. P. Brysch

Gas Composition Revision

Harlow, E. V. GAS COMPOSITION REVISION. U. S. Patent 2,494,554 (1950) January 17.

The invention relates to revising the composition of coke oven gas by diffusion through a porous metallic (Lektro mesh) boundary, the opposite face of which is swept by a countercurrent or concurrent stream of producer gas and steam. Both gases are upgraded, the coke oven gas losing hydrogen (and gaining N_2, CO_2 and H_2O) and increasing in specific gravity, while the producer gas increases in heating value in relation to the amount of H_2 gained. Blast furnace gas may be substituted for the producer gas. The diffusion process may be controlled by adjusting the gas flow rate, the area of the boundary, the gas pressure-drop across the boundary, the molecular weight of the sweep gas, and the amount of steam addition.

O. P. Brysch

Gas Cooling

Craddock, F. E. HEAT AND WATER VAPOR IN CRUDE GAS. *Gas J.* (British) 261, 587-592, 596-598 (1950) *March* 8.

In this discussion of gas cooling it is emphasized that the latent heat of the water vapor constitutes the major portion of the heat to be removed. The sources of the water vapor are traced to the moisture in the coal, reactions involving oxygen in the coal, and miscellaneous additions, such as steam injected into standpipes. Measurements made on gas cooled in atmospheric condensers, with nominal pipe size of 12 in., showed that the gas left the condenser at as high as 173% saturation. The apparently supersaturated condition is presumed to be due to water carried in suspension on tar droplets. This condition is not observed in water-tube condensers, where no part of the gas stream is at a distance much greater than 1 in. from the cooling surfaces. A method for the determination of water in gas is given.

W. E. Ball

Gas Manufacture

Robey, T. L. TRENDS IN GAS PRODUCTION. *Am. Gas Assoc. Monthly* 32, 2-5 (1950) *March*.

The slow, steady, prewar growth of demand for gas was met by gradual plant expansions, usually by adding coke ovens or water gas sets. The greatly increased postwar demand has been accompanied by increased cost of the major raw materials, coal and oil, and by much higher construction costs. The need is for a reasonably low-cost gas of higher Btu content to permit the delivery of more gaseous heat units without expenditures for new mains. The peak-load problem, particularly acute since the war, has been partially solved by the catalytic gasification process which has also proved economical for summer base-load operations where natural gas is available for reforming. High-Btu gases have been successfully produced by three types of oil gas processes, all requiring cyclic operation and all limited to low carbon oils. The Institute of Gas Technology is studying a continuous process for the continuous gasification of all types of oil using fluidized solids as heat

transfer media. Looking toward the day when oil may not be readily available for gas manufacture, the Institute and others are studying the continuous gasification of powdered coal.

J. C. Lane

Holders

Austin, A. F. G. and Johnson, A. H. O. PRESSURE HOLDER INSTALLATIONS. *Gas J.* (British) **261**, 719-727 (1950) *March* 22.

A comprehensive discussion is presented of pressure holder installations. Some of the topics covered include: applications of pressure storage, choice of working pressure, compressor capacity, power consumption, safety, compressor controls, costs, insurance, construction, pressure testing, support, fittings, and design.

W. J. Merwin

Light Oil Recovery

Illingworth, H. S. THE OIL WASHING OF COKE OVEN GAS UNDER PRESSURE. *Gas World* (British) **131** *"Supplement,"* 37-41 (1950) *April.*

Gas from the Hemsworth coke plant must be compressed to 30 psi before entering the distribution system. Comparative tests run at the normal plant pressure and at the distribution pressure showed that, in cases where the gas must be compressed before leaving the plant, significant advantages could be gained by recovering the light oil at the higher gas pressure. Efficiencies as high as 98% were observed at the higher pressure, and organic sulfur was reduced to an average of 7 grains per 100 cu ft.

W. E. Ball

Purification

Collins, L. J. THE USE OF STEAM EJECTORS AS AN AID TO DRY PURIFICATION. *Gas World* (British) **131**, 341-342 (1950) *March* 25.

Revivification of iron oxide in place requires a definite concentration of oxygen in the gas. The author describes the application of a steam ejector for injecting a measured volume of air into the main ahead of purifiers.

W. E. Ball

Gibadlo, F. METHOD OF CONTROLLED PURIFICATION FOR THE SMALLER COAL GAS PLANT. *Gas Age* **105**, 28-30, 60 (1950) *March* 2.

An integrated system of purification control for H_2S, NH_3, and HCN removal is discussed. Curves showing the relationship between NH_3 remaining in coal gas and the concentration of NH_3 in ammonia liquor from the last scrubber compartment; the relationship between NH_3 remaining in coal gas and the rate of water flow through the ammonia scrubbers; and the relationship between NH_3 in coal gas entering oxide boxes and HCN in the gas leaving these boxes are presented. The construction of a simple device for measuring and regulating the flow of water through the ammonia scrubbers is described. The information given is intended to serve as a guide for the practical operation of the purification system in a small coal gas plant.

H. Hakewill

Synthesis Gas

Martin, P. T. SYNTHESIS GAS FROM COAL. *Chem. Ind.* **66**, 365-372 (1950) *March.*

Various methods for producing synthesis gas from coal are reviewed. Various continuous processes are discussed under one of the following types: (1) fixed bed, (2) fixed fluidized bed, (3) suspension or entrained, (4) externally heated retort, (5) slagging generator, and (6) underground gasification. Fifty-four references are given.

C. H. Riesz

Water Gas Production

PRODUCTION OF WATER GAS IN COKE OVENS. *Coke & Gas* (British) **12**, 99-107 (1950) *March.*

Details of design and operating results are given for two 15-oven batteries of Otto Chamber ovens arranged for water gas production by steaming, and built in 1941 and 1944 at the Kiel gasworks. Oven chambers were 13¾ in. wide, 13 ft 1½ in. high and 29 ft long with 10 net tons coal capacity. They are heated by the Otto twin flue system, underjet-fired with

rich or lean gas. Steam, superheated in "Sicromal" steel tubes in the doors, is fed through double sole-channels and thence to the chamber through 9 jets in the 3 lower courses of wall tile. At 1300° C in the flues, 80% steam decomposition is attained (30 lb/Mcf water gas). By admixture of 80 Btu producer gas from oven waste gas, the 290 Btu water gas from steaming, and the residual gases from the coke with the 550 Btu coal distillation gases, a mixed-gas yield of 21,800 cu ft/net ton coal at 420 Btu/cu ft is estimated.

O. P. Brysch

The following articles, the abstracts for which appear on the pages indicated, are also called to your attention:

Gally, S. K. COUPLING DISSIMILAR METALS ADDS TO CORROSION PROBLEMS. p. 86

Hunter, R. G. and Headlee, A. J. W. SPECTROGRAPHIC ANALYSIS OF COAL AND COAL ASH. p. 94

Johnson, C. B. FACTS TO REMEMBER ABOUT METERS AS YOU APPROACH CONVERSION. p. 86

Van Krevelen, D. W. and Baans, C. M. E. ELIMINATION OF CARBON MONOXIDE FROM SYNTHESIS GASES BY ABSORPTION IN CUPROUS SALT SOLUTIONS. p. 94

Wakefield, J. E. PREVENTING CORROSION IN GAS PLANT WITH SPRAYED METALS. p. 87

5. NATURAL GAS AND NATURAL GAS CONDENSATES

Changeover

Johnson, C. B. FACTS TO REMEMBER ABOUT METERS AS YOU APPROACH CONVERSION. *Gas Age* **105**, 35-36, 54-56 (1950) *March* 30.

Upon conversion from manufactured to natural gas, gas meter diaphragms dry out and stiffen, gum forms on valve seats and bearing, glands and packings become sticky and often freeze. The only satisfactory remedy available is the use of oil and/or steam fogging.

E. F. Davis

Compressor Station

Hudson, E. J. HIGHLIGHTS IN MODERN GAS-COMPRESSING PLANT DESIGN TRENDS. *Oil Gas J.* **48**, 160 (1950) *April* 20.

Highlights of new Hudson Engineering designs or installations are presented. Included are a dehydration plant in which drying to 4 lbs of moisture per MMcf is achieved with a liquid, and a propanizer for deethanizing rich oil.

J. D. Parent

Corrosion

Gally, S. K. COUPLING DISSIMILAR METALS ADDS TO CORROSION PROBLEMS. *Am. Gas J.* **172**, 21-23, 26 (1950) *April.*

The corrosion problems resulting from the increased use of copper services and mains in contact with steel mains and services are discussed. The insulation of the two metals plus the use of protective coatings is the preferred method of eliminating these hazards.

B. E. Hunt

Kruger, H. O. and Robinson, M. L. CORROSION OF COPPER BY TRACE CONSTITUENTS OF NATURAL GAS. *Gas* **26**, 31-35 (1950) *April.*

The corrosion of copper by H_2S, mercaptans, and oxygen in natural gas were studied at room temperatures and at elevated temperatures. The results indicate that: (1) H_2S is corrosive

at both room and elevated temperatures, (2) mercaptans were not corrosive at room temperatures but actively corrosive at elevated temperatures, and (3) oxidation above 150°F becomes important and is a function of the critical concentration of oxygen which is temperature dependent.

B. E. Hunt

Wakefield, J. E. PREVENTING CORROSION IN GAS PLANT WITH SPRAYED METALS. *Gas* **26**, 27-30 (1950) *April.*

The advantages of metallizing steel surfaces are discussed. In most cases, the hand application of the metallizing material is completely satisfactory as far as coverage and equal thickness of coating. Special cleaning procedures must be developed when a surface is to be metallized instead of painted.

B. E. Hunt

LP-Gas

Taylor, T. H. THE STORY OF 'CALOR' GAS. I. THE AIM AND THE ACHIEVEMENT. *Gas World* (British) **131**, 337-340 (1950) *March* 25.

The development and growth of the LP-gas industry in England is discussed.

E. F. Davis

Natural Gasoline Plant

Frank, C. W. RESIDUAL GAS BTU CONTROL STRESSED IN NEW PLANT. *Petroleum Refiner* **29**, 123-125 (1950) *April.*

Gas is sold from Magnolia's Hickok gasoline plant to Cities Service Gas Company with a specified minimum heating value of 950 Btu/cu ft. The heating value of the gas leaving the absorbers is controlled automatically by controlling the lean oil ratio with a calorimeter recorder controller.

J. D. Parent

Ragatz, E. C. RICH-OIL RECTIFICATION EMPLOYED TO ACHIEVE FLEXIBILITY AND EFFICIENCY. *Oil Gas J.* **48**, 159 (1950) *April* 20.

Earlier rich oil distillation procedures were primarily demethanizers and did not eliminate the necessity of deethanizing the products; or the sharp cut required between ethane and propane was achieved at the expense of high fuel cost due to low recovery of heat from the lean oil. A new plant is described in which high propane recovery is realized from a very rich low pressure gas. Success depends not only on high recovery in the absorber but a sharp ethane-propane cut in the rich oil deethanizer.

J. D. Parent

Sanderson, C. F. and Glendening, A. S. TRENDS IN THE DESIGN OF NEW PLANTS FOR RECOVERING LIQUIDS FROM GAS. *Petroleum Processing* **5**, 377-378, 381-383 (1950) *April.*

Variations from conventional process design of natural gasoline plants are reviewed for a number of modern installations. The trend toward greater use of air coolers for temperatures above 140°F, the increased use of refrigeration in absorption and the growing use of rich oil deethanization are stressed.

J. D. Parent

Stanley, C. P. PROCESSING METHODS IN A GASOLINE PLANT TO OBTAIN 85 PER CENT PROPANE RECOVERY. *Oil Gas J.* **48**, 157-158 (1950) *April* 20.

This plant uses an absorber with intertray cooling, a rich oil demethanizer, a single still with total condensation and the usual towers for product separation. The deethanizer overhead is 99% ethane. A minimum of propane is lost in the vapors from the absorber, demethanizer and deethanizer so that high recovery is achieved.

J. D. Parent

APPLICATION OF REFRIGERATION RESULTS IN OBTAINING HIGHER YIELDS. *Oil Gas J.* **48**, 166 (1950) *April* 20.

A rich oil deethanizer is described in which there are 20 trays in both the stripping and absorption sections. Hot lean oil from the still heats the liquid from the bottom of the column and then preheats the incoming oil.

J. D. Parent

KATY—3 DESIGNED FOR HIGH PROPANE RECOVERY. *Petroleum Refiner* **29**, 109-110 (1950) *April.*

A new plant to augment facilities at the Katy Gas Cycling Plant is described briefly. The new equipment does not add to the total raw gas capacity as that of existing plants has been diminished. The new unit now handles half of the entire absorption capacity of the Katy Plant, but does not provide for product fractionation, this being done with existing columns.

J. D. Parent

Odorizing

Hyde, M. NATURAL GAS ODORIZING A FUNDAMENTAL FOR SYSTEMS PLANNING TO CONVERT. *Am Gas J.* **172**, 15-16, 47 (1950) *March.*

While the demands for concentrated addition agents which impart a gas-like odor to natural gas and which are stable towards oxidation are being effectively met, low sulfur content and high soil penetration are additional requirements desired by gas companies. In methods of measuring odor level, little progress has been made. The best evidence of adequate odorization is a record of leak complaints plotted on a map of the distribution system. Odorization practices are adequate if the record of leak complaints indicates a minimum of one leak per thousand meters per week, uniformly distributed over the entire system. Additional dividends in safety and gas conservation will result if leak complaints can be conveniently maintained at 2 or 3 times the recommended minimum.

A. J. Rudnitzki

Pipe Lines

Kleinhekse1, S. LIGHTNING ARRESTERS FOR THE PROTECTION OF INSULATED JOINTS IN BURIED PIPE LINES. *Petroleum Engr.* **22D**, 87-90 (1950) *March.*

A small lightning arrester has been designed to protect the phenolic insulating flange gaskets on cathodically protected pipe lines with high resistance external coatings. This unit will prevent burning of the gasket and steel washers. The author advances the theory that the damage is caused by power follow current from high tension transmission lines following a lightning discharge.

O. T. Bloomer

Production

Bielstein, W. J. and Cannon, G. E. FACTORS AFFECTING RATE OF PENETRATION OF ROCK BITS. *Oil Gas J.* **48**, 102-104, 107- 108, 119, 121-122 (1950) *March* 30.

Results are presented of a series of tests to determine the effect of the number of cutting elements and various hydraulic factors on the rate of penetration with rock bits. Definite advantages are indicated for increased circulation rate and high fluid-velocity nozzles directed to bottom of the hole.

O. T. Bloomer

Calhoun, J. C. Jr. ENGINEERING FUNDAMENTALS: CHANGE IN GAS FLOW WITH PRESSURE. *Oil Gas J.* **48**, 125 (1950) *March* 30.

Rock permeability toward gas as calculated by Darcy's law depends on the nature of the gas and the mean pressure as well as on the character of the rock structure. This effect may amount to several per cent for rocks of permeability of about one darcy but may be several hundred per cent for rocks of permeability of about one millidarcy.

J. D. Parent

Abstractor's Note: This effect which is not noted for liquids has been explained by Klinkenberg as slip at the walls. The straight line formula proposed by Klinkenberg is based on ideal gas law behavior and should not apply to actual gases without correction.

Chaney, P. E. ABNORMAL PRESSURES AND LOST CIRCULATION. *World Oil* **130**, 122, 124, 126 (1950) *April.*

A theory is advanced to account for the existence of abnormally high pressure reservoirs on the basis of the increase in volume accompanying the conversion of high molecular weight organic materials to lighter hydrocarbons. This volume increase is more than sufficient to produce a pressure equal to the over-

burden pressure in sealed reservoirs. The theory is developed to account for lost mud circulation by tensile fracture of the formation. This phenomenon would thus be independent of permeability. Corrective measures to the problem of lost circulation should be developed along the line of careful control of all sources of pressure in the bore hole.

O. T. Bloomer

Givens, H. C. LA GLORIA PLANT GETS THREE MAJOR ADDITIONS IN 9 YEARS. *Oil Gas J.* **48**, 180, 183, 203-204 (1950) *April* 20.

A flow sheet is given for the La Gloria casinghead plant. A rich oil deethanizer known as a propanizer-reabsorber is a feature. Instead of heating the lower section, stripping by uncondensed vapor from the still accumulator is practiced.

J. D. Parent

Lambert, T. B. and Hippard, R. M. GAS-OIL-RATIO REPAIR AND CONTROL IN WEST TEXAS AND NEW MEXICO. *Oil Gas J.* **48**, 86-87, 99-100 (1950) *March* 30.

A statistical analysis of gas-oil ratio repair operations in 24 fields in the Permian basin is reported. Many operations were distinctly successful while others were ineffective. A thick oil column and impervious streaks separating oil and gas accumulations are favorable conditions. Cement or other types of squeeze, liner jobs and selective acidization were the most favorable methods.

J. D. Parent

Martin, P. W. FISHING TOOLS AND METHODS. *Petroleum Engr.* **22B**, 7-10 (1950) *March.*

New methods and tools for fishing jobs are presented. A number of illustrations are given.

J. D. Parent

Miller, C. C., Dyes, A. B., and Hutchinson, C. A., Jr. THE ESTIMATION OF PERMEABILITY AND RESERVOIR PRESSURE FROM BOTTOM HOLE PRESSURE BUILD-UP CHARACTERISTICS. T.D. 2849. *Trans. AIME* **189**, 91-104, *J. Petroleum Technol.* 2, (1950) *April.*

The authors present a method for estimating effective permeability and reservoir pressure from the rate of rise in bottom hole pressure when a well is shut in. The method is based on the flow of a homogeneous compressible fluid.

J. D. Parent

Miller, I. A. FREEZING PLUGS IN HIGH-PRESSURE WELLS BY MEANS OF "DRY ICE." *Oil Gas J.* **48**, 95 (1950) *March* 30.

This article is a brief review of the comparatively new technique of using dry ice in plugging high-pressure oil and gas wells to form a temporary, positive bridge of frozen water or mud in tubing or drill pipe so that damaged or fouled-up surface equipment can be removed.

Author's abstract

Rzasa, M. J. and Katz, D. L. THE COEXISTENCE OF LIQUID AND VAPOR PHASES AT PRESSURES ABOVE 10,000 PSI. T.P. 2809. *Trans. AIME* **189**, 119-128, *J. Petroleum Technol.* **2**, (1950) *April.*

Research on the phase behavior of methane and kensol 16, a high boiling oil of narrow boiling range, at pressures up to 25,000 psi and temperatures up to 260°F is presented. Two phases were observed at pressures up to about 12,000 psi. Dew point-bubble point loops, a critical locus curve, pressure-composition, temperature-composition, and K charts are presented.

J. D. Parent

Purification

Campbell, J. A. EXTRACTION OF DUST AND MIST. *Petroleum Engr.* **22C**, 17-18, 23-24, 26-27 (1950) *March.*

The design of the Mist-D-Fier is explained and illustrated. Its use for liquid-vapor separation and for dust removal is discussed.

J. D. Parent

Storage

Boyd, F. A. UNDERGROUND STORAGE OF NATURAL GAS. *Gas Age* **105**, 28-32 (1950) *March* 30.

This paper contains a general discussion of the problems and advantages of underground stor-

age. Data for the Columbia Gas System are supplied. Annual quantities to, from and in storage and possible daily peak deliveries are tabulated and are projected through 1953. Columbia expects to have 42,773 million cu ft in storage December 31, 1953.

J. D. Parent

Rohmann, A. METALLIZING METHOD OF HOLDER PROTECTION USED AT LONG BEACH, CALIF. *Am. Gas J.* **172**, 17-18, 46 (1950) *March.*

The procedure is described by which gas holders were metallized at Long Beach, Calif. Specific recommendations as to sand blasting and metallizing are given.

B. E. Hunt

Spangler, C. V., Bodle, W. W., and Granquist, W. T. NEW, SAFE, PRACTICAL STORAGE AND TRANSPORTATION METHOD FOR LIGHT HYDROCARBONS. *Oil Gas J.* **48**, 170, 172, 193-194 (1950) *April* 20.

Storing light hydrocarbons adsorbed on a granular solid at low temperatures is advocated as safe and practical. Twice the storage volume required for the liquid state is required. Safety due to slow release of gas in case of equipment failure is stressed.

J. D. Parent

Transmission

Geilenkeuser, H. SELF-SUPPORTING PIPE BRIDGES CONSTRUCTED BY THE RUHR GAS CO. *Gas Age* **105**, 22-23, 62, 64 (1950) *April* 13.

The Ruhr Gas Co. has installed several self-supporting pipe spans of 24 in. diameter pipe in the reconstruction of its high pressure gas system destroyed by bombing during the war. Details are given.

J. D. Parent

Kelley, T. B. DISPATCHING A LONG GAS TRANSMISSION PIPE LINE. *Petroleum Engr.* **22D**, 64, 66 (1950) *March.*

The duties and problems of the dispatching department of a transmission pipe line company are briefly discussed.

O. T. Bloomer

Kizer, C. A. AN AUTOMATIC FLOW LINE SAFETY DEVICE. *Petroleum Engr.* **22B**, 53, 55-56 (1950) *March.*

A flow line safety device is described. It is a pressure operated gate valve which closes if the line pressure either rises or falls to values for which controlling pilots are set to act.

J. D. Parent

Love, F. H. MICHIGAN-WISCONSIN LINE A MAJOR PROJECT. *Petroleum Engr.* **22D**, 11-14, 16, 18, 20, 22 (1950) *March.*

A complete description is given of the Michigan-Wisconsin Pipe Line Company's new transmission line from the Texas Panhandle over to points in Michigan and Wisconsin. The main line is 24 in. operating at 970 psig and 22 in. operating at 850 psig. For the initial stage of operations, 155,000,000 cu ft of gas is being handled with an ultimate capacity of 303,000,000 cu ft a day. Three compressor stations having a total of 21,600 horsepower are in operation. Ultimately there will be 15 stations with an installed horsepower of 139,200. Existing underground storage fields in Michigan will be used to store gas in the summer. Details of construction of the line are included with emphasis on river crossings.

O. T. Bloomer

NEW-TYPE GAS ENGINE INSTALLED ON GAS TRANSMISSION LINE. *Power* **94**, 124-125, 188 (1950) *April.*

A new two-cycle, spark ignition, 1600-hp gas engine compressor recently installed on a transmission line of the Tennessee Gas Transmission Company has shown good fuel economy and high overload capacities. The gas engine operates with 40 to 60 psi fuel gas, has a compression pressure of 280 psi compared to the usual 150 psi in conventional gas engines, has special water cooled cylinder liners, and employs straight through scavenging for greater fuel efficiency.

C. Von Fredersdorff

OPERATING TECHNICS FOR NATURAL GAS IN TRANSIT. PART I. Miller, P. H. STANDARDS AND METHODS OF QUALITY CONTROL. *Am Gas J.* **172**, 16, 40, 42-43 (1950) *April;* PART II. Armstrong, E. N. METERING AND REGULATING FOR QUANTITY CONTROL. *ibid* 17-20.

The first section of this set of papers deals largely with the character of gas purchase contracts used by the Texas Eastern line and the tests employed to check the quality of the gas as to such items as moisture and gasoline content, heating value and odorization. The second section deals with the design of orifice meter and pressure control stations for the Transcontinental line. A layout of a meter run together with a regulator system is given.

J. D. Parent

The following articles, which have not been abstracted, are also called to your attention:

Egger, H. W. AUTOMATIC BOOSTER MAINTAINS PEAKLOAD PRESSURES FOR UNITED. *Gas* **26**, 80, 82 (1950) *March.*

PIPE REMOVED WITHOUT UNCOVERING DITCH. *Gas Age* **105**, 23 (1950) *March* 30.

The following article, the abstract for which appears on the page indicated, is also called to your attention:

Austin, A. F. G. and Johnson, A. H. C. PRESSURE HOLDER INSTALLATIONS. p. 85

6. PETROLEUM AND SYNTHETIC LIQUID FUELS

Corrosion

Prange, F. A. CORROSION IN WATERFLOOD OPERATIONS. *World Oil* **130**, 157-158, 160 (1950) *April.*

Corrosion in water-flood operations is very similar, in action, to that encountered in normal oil production. The corrosive agents are the same with the exception of oxygen, which is a more pronounced factor; aggravating factors are also similar, and the methods of control are applicable to both types of oil production.

B. E. Hunt

Ethylene Production

Buell, C. K. and Weber, L. J. ETHYLENE PRODUCTION BY CRACKING OF PROPANE-ETHANE MIXTURES. PART 2. TUBE SELECTION AND INSPECTION. *Petroleum Processing* **5**, 387-391 (1950) *April.*

Experiences with various alloy cracking tubes used for the thermal cracking of propane-ethane mixtures are reported. Erosion of tube metal by hard carbon particles formed in the cracking gas stream constituted the greatest mechanical problem. Wear on each tube became more severe as the coil outlet was approached due to increased gas velocity caused by thermal and cracking reaction expansion. As a result of extensive plant tests, 18-8 Cr-Ni alloy tubes have been found to give the best service near the outlet of the cracking coil while 25-20 Cr-Ni alloy tubes have been employed where the service was less severe. Tests with columbium-stabilized alloys indicated no measurable improvement in life. Surface coating with sodium silicate, although effective in laboratory tests, did not decrease the rate of carburization of the metal. Tests with straight chrome-iron alloys indicated slightly less carbon formation. The difference was not deemed sufficient to justify their use because of the lower creep strength and embrittlement of these alloys. Welded-coil type of construction with return bend castings of 25-20 or 18-8 Cr-Ni alloy has proved feasible.

C. H. Riesz

Fischer-Tropsch Synthesis

Hagy, J. D. GAS PROCESSING FOR THE SYNTHESIS OF HYDROCARBONS. U. S. Patent 2,493,454 (1950) January 3.

A process for the conversion of normally gaseous hydrocarbons (e.g., natural gas) into normally liquid hydrocarbons is described and claimed. The process includes production of synthesis gas, fluidized iron catalyst synthesis, recovery of products, and polymerization of propylene fraction.

C. H. Riesz

Fluid Catalytic Cracking

Thomas, E. J. FLUID CATALYTIC CRACKING OF HIGH-SULFUR STOCKS WITH NATURAL CATALYSTS. *Oil Gas J.* **48**, 221, 224, 228 (1950) *March* 23.

In order to counteract sulfur poisoning of fluid cracking catalyst, attempts were made to add steam to the regenerated catalyst to obtain a hydrated condition. Operational limitations permitted only partial hydration since the plant, charging 26,000 barrels per day, was 100% over design capacity. Partial hydration definitely reduced the poisoning but did not appear economical. However, in April, 1949, a new, low-iron natural catalyst "S.R." was initially added into the unit and materially increased the average catalyst life from 20-25 days to 90-95 days. It has been found that nickel and vanadium present in the charge oil build up on the catalyst. The sum of nickel and vanadium has reached 0.043 weight per cent. This buildup rather than activity decline, may eventually become the factor determining catalyst makeup rate. Further conclusions are not possible at present.

C. H. Riesz

Hydrocarbon Conversion

Fisher, F. R. PYROLYTIC CONVERSION OF HYDROCARBONS WITH RECOVERY OF COKE. U. S. Patent 2,494,695 (1950) January 17.

This is a process for the production of petroleum coke by spraying heavy oils on a bed of hot metal balls (800-1100°F) at 100 to 500 psig pressure. The metal balls are removed intermittently and the coke is broken off by the sudden pressure release. Superheated steam is used to remove remaining hydrocarbons from coke.

H. R. Linden

Hydrogenation

Sherwood, P. W. HIGH-PRESSURE HYDROGENATION OF CARBONACEOUS MATTER. PART IV. THE LIQUID PHASE IN INDUSTRY. *Petroleum Refiner* **29**, 150-154 (1950) *March*.

Equipment used for high-pressure hydrogenation in the liquid phase is discussed. Converters, preheaters, exchangers and catchpots are given particular attention. A peculiarity observed in converters is the "reverse thermosyphon" in which hot fluid recycles to the bottom along the walls. Although the hydrogenation process is exothermic, it is not possible to recover all of the heat by regenerative heat exchangers and a preheater is required to give the final necessary boost in temperature. The preheater which is the most expensive single item in the high-pressure system is gas fired, and finned tubes are set vertically to minimize coking. No steel has yet been developed which is truly satisfactory for preheater operation. In the hot catchpot, conditions are ideal for coke formation, and fluctuations in level or obstructions such as a thermocouple well cannot be tolerated. Isolation of high-pressure vessels and safety precautions reduce the hazards in the operation. Of interest is the practice of installing pilot flames in the high-pressure stalls to prevent dangerous accumulations of hydrogen.

C. H. Riesz

Petroleum Properties

Holliman, W. C., Smith, H. M., McKinney, C. M., and Sponsler, C. R. COMPOSITION OF PETROLEUM: PROPERTIES OF DISTILLATES TO 600°F. U. S. Bureau of Mines Technical Paper 722 (1950)

Data is presented on the properties of ten selected American crude oils and their distillate fractions. Data is used to develop and expand correlations whereby the B.M. routine analysis may be used to determine the prob-

able value of a crude oil. Methods of approximating ASTM boiling range, sulfur content, viscosity at 100°F and −40°F, aromatic content and aniline points of distillate fractions from crude oil routine analyses are presented.

D. L. Nicol

Platforming

Haensel, V. PLATFORMING APPROACHES THE IDEAL SOLUTION FOR REFORMING LOW-OCTANE AND STRAIGHTRUN GASOLINES. *Oil Gas J.* 48, 82-85 (1950) *March* 30.

Platforming is the name given to the catalytic reforming of gasoline over platinum catalyst. High-octane, low-sulfur gasoline is obtained. The four major operating variables are temperature, space velocity, pressure and hydrogen recycle rate. The nature of the product and yields are controlled by these variables as shown by laboratory and pilot-plant data.

C. H. Riesz

Haensel, V. COMMERCIAL PLATFORMING AT OLD DUTCH REFINERY. *Oil Gas J.* 48, 85 (1950) *March* 30.

The operation of the first commercial Platforming unit at Old Dutch Refining Company, at Muskegon, Michigan, is described. Plant throughput has been varied from 1000 to 1500 barrels per day as required. Average catalyst temperature was 860-890°F and pressure was 700 psig. During four months of use, the platinum catalyst has shown no indication of deactivation.

C. H. Riesz

Refining

BLUE PRINT OF 1950 REFINING. *Oil Gas J.* 48, 171-210 (1950) *March* 23.

A simplified flow diagram and brief discussion is presented for each of 39 petroleum refining processes.

C. H. Riesz

Synthetic Liquid Fuels

Torrey, P. D. POSSIBILITIES FOR PRODUCTION OF LIQUID FUELS FROM SHALE, NATURAL GAS, AND COAL. *Petroleum Engr.* 22A, 39-44 (1950) *March.*

Production of synthetic liquid fuels from oil shale, natural gas and coal is reviewed. The oil produced from shale oil is not the equal of crude oil but must be considered as a cracked product which requires extensive processing. Production of synthetic liquid fuels from natural gas can be done economically in only a few localities since a reserve of about one trillion cubic feet is needed to ensure an operating life of 25 years for a 10,000 barrel/day plant. However, the fact that synthetic liquid fuels can possibly be made will tend to discourage unrestricted waste of gas.

C. H. Riesz

The following article, the abstract for which appears on the page indicated, is also called to your attention:

Dowden, D. A. HETEROGENEOUS CATALYSIS. p. 95

7. ANALYTICAL METHODS AND TESTS

Coal Analysis

Hunter, R. G. and Headlee, A. J. W. SPECTROGRAPHIC ANALYSIS OF COAL AND COAL ASH. *Anal. Chem.* 22, 441-445 (1950) *March.*

The Littrow spectrometer, with the total energy method, was used to determine ash content and composition on 70 samples of West Virginia coals. Correction curves for concentration of SiO_2 and Al_2O_3 in standard samples permitted checks of this method against the usual burning method within ± 1% in 97% of the tests. Wet analyses of coal ash and spectrometer analyses of the coal agreed well in a number of cases, although the wet analyses were not sufficiently accurate for spectrometric standards. The results permit calculation of ash softening temperatures and can be applied to control of tipple and washery operations.

O. P. Brysch

Mass Spectrometer

Burmaster, K. E. and Evans, E. C. THE MASS SPECTROMETER: ITS ACCOMPLISHMENTS, APPLICATIONS AND FUTURE. *Instruments* 23, 242-245 (1950) *March.*

The design, construction and uses of the mass spectrometer are reviewed. Brief reference is made to its application to isotope separation, organic structural determination, metabolic processes, analysis and control, and leak detection in plant installations and pipe lines. Some potential fields of application are outlined briefly.

S. Katz

8. GENERAL AND PHYSICAL CHEMISTRY

Adsorption

Pierce, C. and Smith, R. N. HEATS OF ADSORPTION. III. METHANOL ON CARBON. *J. Phys. & Colloid Chem.* 54, 354-364 (1950) *March.*

The absorption of methanol on a non-porous carbon surface is a new type, designated as type VI. Adsorption of the first layer is quite complete before multilayer adsorption occurs. An interpretation of the adsorption isotherms in terms of the distribution of active sites capable of adsorbing at given pressures is given. A comparison of methanol adsorption isotherms on porous and non-porous carbon surfaces shows heats of adsorption to be much higher on the former.

S. Katz

Carbon Monoxide Absorption

Van Krevelen, D. W. and Baans, C. M. E. ELIMINATION OF CARBON MONOXIDE FROM SYNTHESIS GASES BY ABSORPTION IN CUPROUS SALT SOLUTIONS. *J. Phys. & Colloid Chem.* 54, 370-390 (1950) *March.*

The mechanism for the absorption of carbon monoxide by ammoniacal cuprous salt solutions was determined to proceed as follows: $Cu(NH_3)_2^+ + CO + NH_3 = Cu(NH_3)_3CO^+$. Formulae were then derived relating carbon monoxide equilibrium pressures as a function of temperature, the copper ammonia and carbon monoxide content, and the ionic strength of the solution. Correlation between experimental data and theory were satisfactory. Absorption rates were also determined. It was found that in solutions containing an excess of free ammonia, the reaction between carbon monoxide and cuprous salts was immeasurably rapid and the rate of mass transfer of the reaction product (the carbon monoxide-copper complex) was controlling. In weakly ammoniacal or in neutral solutions (no free ammonia), the rate of absorption was much smaller and the chemical reaction velocity was partly rate controlling.

C. H. Riesz

Diffusion Properties

Winter, E. R. S. DIFFUSION PROPERTIES OF GASES. PART III. THE DIFFUSION AND THERMAL DIFFUSION COEFFICIENTS FOR ISOTOPIC GASES AND GAS MIXTURES. *Trans. Faraday Soc.* (British) **46**, 81-92 (1950) *February.*

The diffusion and thermal diffusion properties for isotopic gas mixtures and other gas mixtures were calculated by assuming various molecular models of gases postulated by different persons interested in the properties which depend on the interaction energy of gas molecules. These values were compared with experimental values. Much of both experimental and calculated values were lacking, but where they were available agreement was fairly good.

S. Mori

Gaseous Detonations

Berets, D. J., Greene, E. F. and Kistiakowsky, G. B. GASEOUS DETONATIONS. I. STATIONARY WAVES IN HYDROGEN-OXYGEN MIXTURES. *J. Am. Chem. Soc.* 72, 1080-1086 (1950) *March.*

Experimental detonation velocities in H_2-O_2, H_2-O_2-He and H_2-O_2-A systems at the near-stoichiometric range of compositions agree with calculations by the Chapman-Jouget theory. This may be due to the buffering action of the high concentrations of dissociated species. There is some evidence that deviations from theory may be due to non-equilibria with respect to internal heat capacity of polyatomic molecules and with respect to chemical reactions.

A. J. Rudnitzki

Berets, D. J., Greene, E. F. and Kistiakowsky, G. B. GASEOUS DETONATIONS. II. INITIATION BY SHOCK WAVES. *J. Am. Chem. Soc.* 72, 1086-1091 (1950) *March.*

Experiments are described in which H_2-O_2, C_2H_2-O_2, and CH_4-O_2 mixtures at atmospheric pressure were detonated by plane shock waves transmitted by inert gases. Weak shocks are transmitted through the detonable mixtures with slow decay. More intense shocks exhibit slowly rising velocities in the detonable mixtures, which may be followed by the development of full detonation. In the latter case, full detonation was consistently preceded by "overshoot" velocities in excess of the steady-state detonation velocity. Shocks of the highest intensity resulted in immediate establishment of the detonation wave with no "overshoot." The data are considered in the light of accepted theory.

A. J. Rudnitzki

Heterogeneous Catalysis

Dowden, D. A. HETEROGENEOUS CATALYSIS. PART I. THEORETICAL BASIS. *J. Chem. Soc.* (British) **1950**, 242-265 *(January).*

An attempt is made to find fundamental correlations between catalytic activity and the physical structure of solids. In heterogeneous catalysis, the reaction rate is believed to be controlled by the formation of a chemisorbed complex. This complex may be bound to the solid catalyst surface either by ionic or by covalent bonds. Conditions leading to optimum formation of positive ions and of negative ions are considered. Covalent bonding is treated qualitatively using Pauling's concept of transitional metal valencies and the electron band theory. It is suggested that insulator catalysts (e.g., — alumina) function through a proton exchange mechanism particularly at cation defects.

C. H. Riesz

Reynolds, P. W. HETEROGENEOUS CATALYSIS. PART II. HYDROGENATION BY BINARY ALLOYS. *J. Chem. Soc.* (British) **1950**, 265-271 *(January).*

Powdered nickel-copper catalysts of the Raney type were prepared. With increasing copper content, the specific surface decreased rapidly until at 40% of copper, the specific surface had fallen to 11% of that for pure nickel. The activity of these catalysts in benzene hydrogenation fell at a greater rate to a negligible activity value at the same composition. The magnetic susceptibility also fell to an insignificant value. Similar studies were also made with granular alloy-skeletal catalysts and with kieselguhr-supported nickel-copper catalysts. The results indicate that the catalytic activity of nickel falls

in parallel with the filling of its d-band holes by the valency electrons of the copper. This occurs while the lattice is expanding and would be in the direction of increased activity on the basis of the simple geometric theory.

C. H. Riesz

Kinetics

Bryce, W. A. and Hinshelwood, C. THE REACTION BETWEEN PARAFFIN HYDROCARBONS AND SULFUR VAPOR. *J. Chem. Soc.* (British) 1949, 3379-3387 (*December*)

A kinetic study has been made of the reactions of paraffin hydrocarbons between ethane and octane and sulfur vapor. It is suggested that the reactions occur as a chain, initiated by atomic sulfur. A mechanism has been derived which is first order with respect to the hydrocarbon, and approximately of zero order with respect to sulfur, in moderately good agreement with the experimental evidence.

S. Katz

Thermodynamics

Roegiers, M. VAPOR PRESSURE, SURFACE TENSION, VISCOSITY AND EQUILIBRIUM PROPORTIONS OF IDEAL MIXTURES. (3) *Petroleum* (British) **13**, 83-84, 90 (1950) *April.*

A mechanical device is described for use in computing the viscosity-composition characteristics of hydrocarbon mixtures from the properties of the separate constituents. Similar treatments of vapor pressure of ideal binary mixtures are proposed.

S. Katz

Rice, W. T. CHARTS SOLVE POLYTROPIC P-V-T RELATIONS FOR THE PERFECT GASES. *Chem. Eng.* 57, 120-122 (1950) *April.*

A system of three generalized charts relating the polytropic pressure, volume and temperature relation of gases has been prepared. The data are ploted as ratios of the initial and final states; thus P_2/P_1 is plotted against V_2/V_1 and T_2/T_1, and V_2/V_1 is plotted against T_2/T_1, for a range of volumes of the polytropic constant. The simplicity with which calculation of ideal gas systems may be made with these charts is illustrated in a series of examples.

S. Katz

The following articles, the abstracts, for which appear on the pages indicated, are also called to your attention:

Andersen, J. W. and Fein, R. S. MEASUREMENT OF NORMAL BURNING VELOCITIES OF PROPANE-AIR FLAMES FROM SHADOW PHOTOGRAPHS. p. 81

Campbell, J. R., Cumming, A. P. C. and Horn, J. A. STUDIES IN ACETYLENE FLAMES. p. 81

10. CHEMICAL ENGINEERING

Gas Temperature Measurement

Dahl, A. I. MEASUREMENT OF HIGH TEMPERATURES IN GAS STREAMS. *Petroleum Refiner* **29**, 115-122 (1950) *March.*

Gas temperature measurements are subject to errors from conduction and radiation effects. To minimize conduction effects, the smallest practical size of thermocouple wire and protection tube should be utilized and immersion should be as deep as possible. To minimize radiation effects, thermocouples should be installed with multiple shields of low emissivity. Another method is to use the suction type of probe wherein gas flows at high velocity past the thermocouple. Under certain conditions it is possible to use a pneumatic type of gas temperature measurement device wherein the temperature is proportional to the pressure drop across an orifice. Diagrams are presented of various means of shielding thermocouples.

W. J. Merwin

Heat and Mass Transfer

Kettenring, K. N., Manderfield, E. L. and Smith, J. M. HEAT AND MASS TRANSFER IN FLUIDIZED SYSTEMS. *Chem. Eng. Progress* **46**, 139-145 (1950) *March.*

A study was made of heat and mass transfer in a fluidized bed of silica gel and alumina in a 2.3 in. diameter glass column. It is concluded that the heat transfer coefficient between solid and gas is lower than that in a fixed bed, but

because the small particles in a fluid bed have considerably greater area, the overall heat transfer rate can be quite high. An equation is presented for the mass transfer coefficient which correlates the coefficient with partial pressure, mass velocity, gas viscosity and particle size.

W. J. Merwin

Suspensions of Solids

Korn, A. H. HOW SOLIDS FLOW IN PNEUMATIC HANDLING SYSTEMS. *Chem. Eng.* 57, 108-111 (1950) *March.*

The author discourses on the mechanism by which solids are transported by gases and proposes an equation wherein the specific pressure drop is an exponential function of the specific loading. The constants in the equation proposed are said to be functions of two or more other variables. One of these is the terminal velocity of the solid particle and the others are pipe diameter, specific gravity of the material transported, and the velocity head of the fluid. The available literature data are reexamined by the author and the calculated constants for his equation are tabulated.

W. J. Merwin

Unit Operations Review

CHEMICAL ENGINEERING UNIT OPERATIONS. *Ind. Eng. Chem.* 42-76 (1950) *January.*

The fifth annual Unit Operations Review includes reviews of the year's literature by authorities. The subjects covered are: absorption and humidification; adsorption; centrifugation; crushing and grinding; crystallization; high temperature distillation; high vacuum distillation; drying; evaporation; solvent extraction; filtration; fluid dynamics; heat transfer; ion exchange; materials handling; and mixing. Extensive bibliographies are included in each section. The following sections are considered of especial interest to the gas industry.

Pigford, R. L. ABSORPTION AND HUMIDIFICATION. *Ind. Eng. Chem.* 42, 17-19 (1950) *January.*

Progress in absorption and humidification has been made in the fields of liquid and gaseous coefficients, performance of packed towers, mass transfer in fluidized beds, and absorption and chemical reactions. Design methods and considerations have also been covered as well as operation of plant equipment. A bibliography of 40 references is included.

C. L. Tsaros

Harris, B. L. ADSORPTION. *Ind. Eng. Chem.* 42, 20-24 (1950) *January.*

Recent work in the field of adsorption is reviewed under the section headings of adsorption equations, surface area and particle size studies, porosity, chromatography, liquid phase studies and experimental developments. Much current work deals with the BET equation and its modifications especially with relating it to classical adsorption equations. A bibliography of 208 references is supplemented with a cross reference index under the headings of adsorbates and adsorbents of major interest.

S. Katz

Skaperdas, G. T. HEAT TRANSFER. *Ind. Eng. Chem.* 42, 62-65 (1950) *January.*

The author mentions most of the books and articles published on heat transfer in the last year. The material is classified under subtitles such as surface boiling, compressible flow of air, fluidized systems, convection, condensation and boiling, direct contact convection, conduction, service and design data, and miscellaneous topics. The article also includes a bibliography of 80 references.

R. E. Peck

11. PROCESS EQUIPMENT AND INSTRUMENTATION

Centrifugal Pumps

Lobanoff, V. STUFFING BOXES FOR CENTRIFUGAL PUMPS. *Petroleum Engr.* 22C, 33-36 (1950) *March.*

The function of a stuffing box is to prevent leakage along the shaft of the pump. Packing usually minimizes the leakage rather than preventing it completely. Five types of packing gland are discussed and drawings presented. The complexity of design increases as the pressure and temperature increase.

C. L. Tsaros

Flow Control

REFINER'S NOTEBOOK: FLOW CONTROL. *Oil Gas J.* 48, 123 (1950) *March* 30.

The flow control system for a depropanizer and a debutanizer tower system is briefly discussed and flow diagram are presented. A liquid level controller on the feed accumulator is used to reset the control point of a flow controller on the feed stream. Reflux rate is controlled by pressure drop through an orifice. Another possibility is to have a level controller on the feed accumulator reset the control points of the feed and reflux flow controllers.

W. J. Merwin

Orifice Research

Partridge, F. M. PRELIMINARY TEST RESULTS IN AGA-ASME ROCKLAND ORIFICE RESEARCH. *Gas* 26, 77-77, 81 (1950) *April.*

A series of orifice meter tests are now being conducted by a joint AGA-ASME committee at Rockville, Md. The purpose of these tests is to evaluate the effect of the following factors on orifice meter measurement: (1) disturbances caused by various valves and fittings upstream to the meter; (2) effect of pipe sizes; (3) size and location of pressure tap holes; (4) comparison of select pipe with bored or machined meter tubes; (5) comparison of orifice fittings and standard flanges for holding orifice plates. The method of conducting the tests is outlined, but no results are presented.

O. T. Bloomer

Plant Cost

Brooks, G. E. HOW TO ESTIMATE PLANT CONSTRUCTION COSTS. *Petroleum Engr.* 22C, 7-10 (1950) *March.*

This is the first of a series of articles on estimating plant construction costs. In making a preliminary estimate the estimator should have knowledge of the type of plant, climatic conditions and other factors, experience in estimating other plants, and accumulated cost data on previously erected plants. Sample forms are presented for tabulating cost data and for making the calculations for the preliminary cost estimate.

W. J. Merwin

Chilton, C. H. "SIX TENTHS FACTOR" APPLIES TO COMPLETE PLANT COSTS. *Chem. Eng.* 57, 112-114 (1950) *April.*

A plot of plant cost versus plant capacity is presented which shows that the cost of a second size plant which is x times the size of the first plant may be obtained by multiplying the known cost of the first size plant by x raised to the 0.6 power.

W. J. Merwin

Pressure Control

THE REFINER'S NOTEBOOK: PRESSURE CONTROL. *Oil Gas J.* 48, 351 (1950) *March* 23.

Sketches are presented of six methods of controlling the pressure of a fractionating tower. These are as follows: (1) the control valve is placed on the non-condensibles stream; (2) the control valve is placed ahead of the condenser; (3) the control valve is placed on the water stream to the condenser; (4) the pressure controller resets a flow controller on the water to the condenser; (5) the control valve is placed on the liquid from the reflux drum and pressure control is obtained by partial flooding of the condenser; (6) two control valves are placed on the tower overhead and one by-passes the condenser.

W. J. Merwin

Symbol Standardization

Beard, C. S. STANDARDIZATION OF PROCESS INSTRUMENT SYMBOLS. *Petroleum Refiner* 29, 97-101 (1950) *March.*

The author presents a list of abbreviations and process control symbols which he believes are useful in making up flow sheets and urges others to adopt some kind of standard system of symbols.

W. J. Merwin

Water-Cooling Towers

Degler, H. E. WATER-COOLING TOWERS. *Petroleum Engr.* 22C, 29-30 (1950) *March.*

The elementary principles of water cooling towers are presented. The following terms are defined: cooling range, approach, heat load, pumping head, drift, blow-down, make-up.

W. J. Merwin

The following article, the abstract for which appears on the page indicated, is also called to your attention:

Baulk, R. H. INSTRUMENTS AND TECHNIQUES IN INDUSTRIAL HEAT-TRANSFER RESEARCH. p. 82

12. MATERIALS OF CONSTRUCTION

Corrosion

Anderson, E. A. THE CORROSION PRODUCTS ON ZINC ANODES USED UNDERGROUND. *Corrosion* 6, 129-131 (1950) *April.*

The corrosion products present on zinc anodes after underground use were analyzed. The corrosion products formed in two distinct layers; the inner consisting of a porous deposit of basic zinc sulfate, while the outer deposit consisted of a dense mixture of basic zinc sulfate and carbonate. A hypothesis for the formation of these products is presented.

B. E. Hunt

Volkening, V. B. CORROSION OF STEEL PIPE BY CHLORINATED SEAWATER AT VARIOUS VELOCITIES. *Corrosion* 6, 123-128 (1950) *April.*

Corrosion rates of steel pipe in sea-water were obtained for six residual chlorine concentrations ranging from 0 to 4.0 ppm at five seawater velocities from 0.1 to 6.4 ft per sec. Pitting rates were accurately measured and compared with weight loss corrosion data. The minimum effective dosage of chlorine was determined for elimination of marine fouling organisms. A simple accurate method for the determination of residual chlorine in seawater is also discussed.

Author's Abstract

The following articles, the abstracts for which appear on the pages indicated, are also called to your attention:

Gally, S. K. COUPLING DISSIMILAR METALS ADDS TO CORROSION PROBLEMS. p. 86

Wakefield, J. E. PREVENTING CORROSION IN GAS PLANT WITH SPRAYED METALS. p. 87

13. NEW BOOKS

Coal, Coke and Coal Chemicals

Wilson, P. J., Jr. and Wells, J. H. COAL, COKE AND COAL CHEMICALS. *New York, McGraw-Hill Book Company, Inc.*, 1950.

This treatise, based upon lecture material for war training classes, was written with the intention of presenting a systematic description of present carbonization practice. All aspects are discussed, from the origin of coal to the recovery of such products as carbazole and dicyclopentadiene. In a volume of this size, it would not be expected that all topics could be treated comprehensively, but in most cases references to a more detailed presentation are given. Because of the authors' background, the chapters on coal chemicals will be found to be particularly informative and up-to-date. The section on low-temperature carbonization and the Curran-Knowles process is very timely, in view of the current interest in smoke abatement. In the two final chapters, on economics and trends, there is presented a management-research view of the industry not ordinarily found in publications of this type. Taken as a whole, this book should prove to be of great value as a ready reference to almost any aspect of an industry that is becoming increasingly complex.

W. E. Ball

Thermodynamics

Quill, L. L. THE CHEMISTRY AND METALLURGY OF MISCELLANEOUS MATERIALS: THERMODYNAMICS. *New York, McGraw-Hill Book Co., Inc.*, 1950.

This volume is a somewhat heterogeneous compilation of the thermodynamic properties of a large number of elements and compounds investigated by the Metallurgical Project, the wartime predecessor of the Argonne National Laboratory. Studies included range from phase diagrams of alkaline earth halides and metal-metal halide systems to extremely detailed compilations of the thermodynamic properties, fusion, and vaporization data of most of the halides. Of especial interest are careful compilations of the thermodynamic and physical properties of the elements. This includes enthalpies, entropies, and the free energy function, $-(F-H_{298})/T$ to 2000° K for the solid, liquid and gaseous states, and the heats and entropies of vaporization. Thermodynamic properties of the common gases are included; methane is the only hydrocarbon listed. Enthalpies, entropies, free energies and heats of formation are given. A very complete reference list in included.

S. Katz

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